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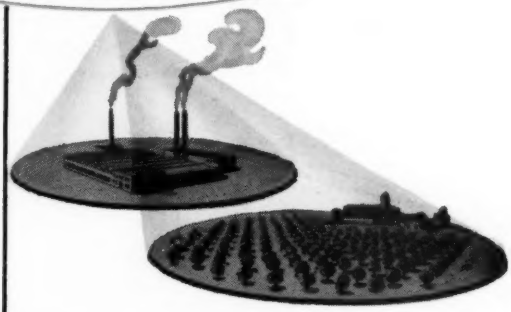

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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXVII NO. 6

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Better Crops with PLANT FOOD

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We must make . . .

Adjustments

Jeff McDermid

HUMANS are such devotees of routine and customary surroundings and influences that I often smile at the fear we hear expressed by politicians to the effect that we must constantly be alert lest we lose our independent self-reliance and command of the situation in general, and thereby gradually be completely "regimented." I hold that we like more or less regimentation and enjoy having someone tell us what to do and when, especially if it is something we gain comfort or advantage from performing, experiencing, or using. Making painful or awkward adjustments when a sudden break disrupts the even tenor of one's compliance with a form of regimentation or routine that has grown deep in the pattern of our behavior is, I believe, a harder experience to fathom and control than to surrender to that stuffed bogy we have learned to call "regimentation."

Begin with infancy and carry it on through all of life's incidents and you may also find that adjustments accepted and adopted frankly and firmly are not only vitally neeessary to maintain mental poise and kindly outlooks to the world, but to save us and our associates and relatives from a chaotic state.

Even the toddler has to meet and make adjustments. He's bound to get into trouble or stir up a delayed chain reaction among his brothers and sisters and his pa and ma if he insists on regimenting the family to satisfy his every whim and soothe his grouches. It's true that sometimes such a prodigy

gets his way for awhile and rules the roost—if he has been sick or badly mauled. But normally the kid with an ogre's disposition and a Soviet urge for despotism sooner or later finds that he is merely an addition to the family and not the center of the whole domestic shebang.

I DARE say that the kid raised by himself by doting parents is able to postpone some of the necessary social adjustments for a few years longer than the brood of youngsters in a crowded household where children are prized but not idolized. But later he's bound to shed his apron-string ties and do some mingling with juveniles who are out to regiment and adjust all their companions who never enjoyed the benefits of being made a conformist cooperatively. If he puts up some foolish resistance to the process which is introduced to him as a sign that he must accept the thorns as well as the sugar in a democratic community, he is apt to get the grand goodbye or a swift kick in the region of the *os inominatum*. Either the silent scorn and ostracism of his fellow fledglings or the force and feeling engendered by a resort to whilom violence will soon make him adjust his nature and behavior to the somewhat set pattern of a standardized but workable kind which we so seldom regard as "regimentation."

As he gathers stature, pimples, and puberty, the gauche youth never puts up as stiff a fight to maintain his own personal dictates and whims as he tried to in the post-diaper period. I have hardly ever seen and have never myself been accused of rebellion against the mores that are the sign manual and ruling code of the high school body. Maybe in some unguarded and retrospective moment an individual belonging to that elite clan of budding collegiates may imagine he is in revolt, and picture himself as a free-thinker and a courageous radical.

But his kind are few indeed. If the pack adopts funny hats or wears outrageous patched cover-alls or lets their hair grow long and mussy, or pokes fun at some stodgy but patient teacher, all of them at once become regimented and driven headlong into the same adjustment. It's the lonely one who shrinks from the popular thing, who cannot ease his mind and manners through becoming adjusted. Often he never does get adjusted, much to his own sorrow and the pity of his generation. Perhaps if he had been a regular leader and a sticker, his will and not theirs might have prevailed. And even then, adjustments would be necessary for those who chose to follow him. Every time you change your mind and take a new tack, adjustments are in order, whichever way.

Modern medicine and surgery have rescued countless men and women from premature death, and there has been a sharp reduction in the mortality rates. Yet departing widely from the humane and sympathetic doctrine for healers that the patron saint Hippocrates upheld, there has arisen for most of us a form of regimentation to which nearly everyone must become adjusted when seeking medical aid.

THE traditional ways of healing have considerably changed—from simple and intimate relationships to this kind of a situation, spoken of by the well-known Dr. Herbert A. Ratner in an essay on the present routine that patients undergo: "Modern man goes through life fearing death, and fearing death, expends his health in hypochondriacal distress; who becomes a vitamin-taking, antiacid-consuming, barbiturate-sedated, aspirin-alleviated, weed-habituated, alcohol-inebriated, benzedrine-stimulated, surgically despoiled animal. Nature's highest product becomes a fatigued, peptic-ulcerated, depressed, sleepless, headachy, nicotinized, overstimulated, neurotic, tonsilless creature."

Far too frequently a hospital patient and those who stand by his bedside are merely a number in a ward, subject to whims and experiments under a system that grants little choice to the sick one and administers an appalling array of

nostrums and injections which, if given to a well and hearty person, would lay him low. Despite the good that comes from science and safety following proper use of the antibiotics and other newer drugs, no one can deny that this is a field where free choice and independence give way to rigid technical procedures. He who tries to question and find out what and why is met with a solemn shake of the head and a further arbitrary dose of mysterious pills and potions. Yet we boast of our threatened freedom of action and decision instead of acknowledging that modern life habits and customs have virtually denied those inherent privileges to most of us before the politicians entered the picture.

When a fellow finds himself obliged to leave home for a job in a strange new environment, he surely needs to call upon his serenity and balance to see him through. For now he meets with different rules and regulations to which he must try to conform without losing self-respect or ambition. All old moorings and reliable landmarks he grew to like in his youth have given place to unfamiliar, and to him, untried courses and goals.

He can't be stiff and cool toward his new bosses and associates, even when his nature is to be shy and reserved. He can't get fresh and crude in his humor and behavior while trying hard to appear to be likable and socially acceptable. The work hours seem long and the off-hours longer still, which spells the heaviest burden of adjustment for those who first begin to shoulder the burdens of a wage earner on his own.

That he makes the necessary crossing from the era of carefree youth to the job-holding time under some system of compulsion is something he may not clearly see. But it's there in a multitude of ways that he is penalized for overlooking or ignoring. Like a style manual for the editor and printer or a fashion design for the society dame, the customs and traditions of his shop or office become a virtual dictator. Often the details thus insisted upon are such as to broaden and invigorate his work and improve his mentality and skills. Just as often they may be a ruthless weight on those youthful ideals and goals of "high emprise" with which beginners start to pull an oar in the hectic regatta of commercial competition. Agriculture is about the only craft where recruits see little of this condition of employment—but there, too, one makes adjustments to reach the market right and fend off foreclosure.

FOR agriculture and farm life, the adjustments spoken of here are experienced in an entirely different setting than are those which are forced upon the urban earner and provider. Making adjustments has been a customary, albeit a painful necessity, to those who have spent most of their lives at farming in our old valley. This has been true from the raw and troublesome times of original settlement, when those who cast their lot with the husbandmen along the valley were always faced with all kinds of obstacles and hurdles to challenge and perplex them.

Floods came tearing down the usually peaceful river and wrecked farms and homes into which had gone numerous fond daydreams and many labors, prayerful hopes and anxious planning. Surely this was a bitter dose to swallow, taking a strong community to accept and overcome. But finally the remedies were forthcoming and resolves

(*Turn to page* 43)

The Development of the

American Potash Industry

By J. W. Turrentine

Washington, D. C.

THE development of the American Potash Industry is a continuing story. Through education by Federal, State, and private agencies the farmer is learning more and more about the essentiality of potash in balanced ratios to other plant foods in the efficient and profitable production of agricultural commodities. The result is an ever-increasing demand and consumption and therefore increasing production of potash salts. This in turn leads to the development of new potash mines and refineries and the expansion of the old with improved facilities and products.

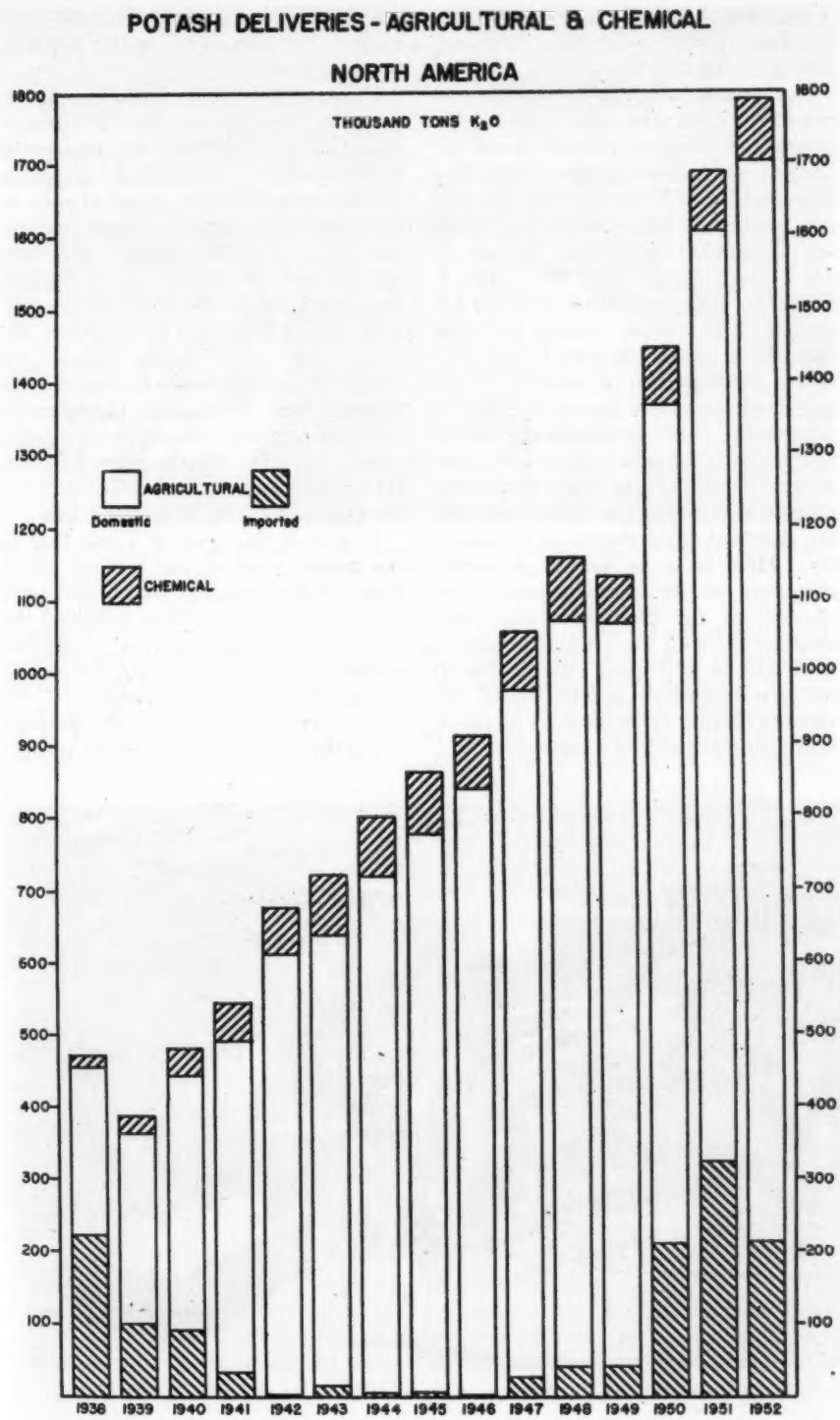
In tracing the development of the American potash industry, the logical place to start would seem to be the beginning even though the story has often been told; and the beginning may be described as that point in our agricultural history when we first realized our state of utter dependence on a single foreign source for our supplies of potash salts which we had been taught to use and which we had learned were essential in scientific crop nutrition.

The date was 1910 and the single source of commercial potash salts was Germany. There the potash industry had been over-expanded to the point where surplus production and competitive selling were reducing to near bankruptcy many of the factors except the lowest cost producers, with resulting chaos. To save the industry the German government organized a trust, closed down the less profitable mines, assigned production to the more profitable mines and fixed the prices at which potash salts could be sold.

This resulted in the cancellation of favorable contracts with the American buyers, who brought their troubles to Washington after the good, old traditional manner and were told that the proper solution of the problem was the severance of dependence on Germany through the establishment of domestic sources of potash—if such could be found and developed. Subsequently a Congressional appropriation became available in 1911 for exploration in the United States for occurrences of minerals, salines, brines, and seaweeds from which potash could be produced.

Those explorations and surveys were most opportune, for in 1914, with the outbreak of World War I, German importations were abruptly terminated and we were left deprived of all potash supplies. Thereupon, under the impetus of a price increase from $35 to $500 per ton of 50% muriate, practically all of the potash-bearing raw materials (and industrial wastes) listed as the result of Federal surveys were placed under industrial development, resulting in the construction of 128 production units, with an output of 209,000 tons of salts containing 54,800 tons K_2O by 1918, and a rated but unrealized capacity considerably in excess of that.

The critical nature of the emergency did not admit of technological research. On the contrary, potash was being extracted in many instances "by main force and awkwardness." As a result, with the reappearance of German potash on the American market at a carefully regulated descending scale of


POTASH DELIVERIES - AGRICULTURAL & CHEMICAL
NORTH AMERICA
THOUSAND TONS K_2O
AGRICULTURAL
Domestic
Imported
CHEMICAL
1800
1700
1600
1500
1400
1300
1200
1100
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1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952

prices, the wartime domestic industry faded away with only three units surviving to recent years.

But potash research continued and one of the enterprises that survived the post-war deflation in potash interest developed its processes to the competitive basis and became a major factor in potash production—the American Potash and Chemical Corporation, the American Trona Corporation of World War I. Since that time, beginning with the extraction of potassium chloride from the complex brines of Searles Lake, California, through dint of continuous and persistent research it has undergone development after development, added product after product from the raw material processed, to reach its present state of constituting one of the outstanding chemical achievements of this country. Here is to be found phase-rule chemistry in its most intricate form applied on the plant-wide scale and mechanized with the greatest precision.

It was in this plant that occurred the first large-scale application of the vacuum-cooling crystallization of potassium chloride yielding a product of 97% purity which established the now well-known "60% muriate" as the standard potash grade.

Prior to 1926, surveys for the search for potash resources had been restricted to what might be called surface aspects of the problem, outcroppings of potash minerals, the less pure strata of sodium chloride in salt mines already opened, and subterranean brines from salt springs and oil wells. No funds had been provided for the exploration otherwise of the Nation's great saline deposits with which it was well known from German explorations that potash deposits were associated. Conspicuous and least explored among these salt deposits was that of the vast Permian Basin underlying parts of Texas, New Mexico, and the states to the north.

It was in this area of Texas that in the examination of the natural brines from oil-well drillings potash salts were found in solution. Then followed the discovery of fragments of crystalline potash minerals, indicating the occurrence of potash segregations in the saline strata penetrated by the borings.

On the basis of such evidence, meager

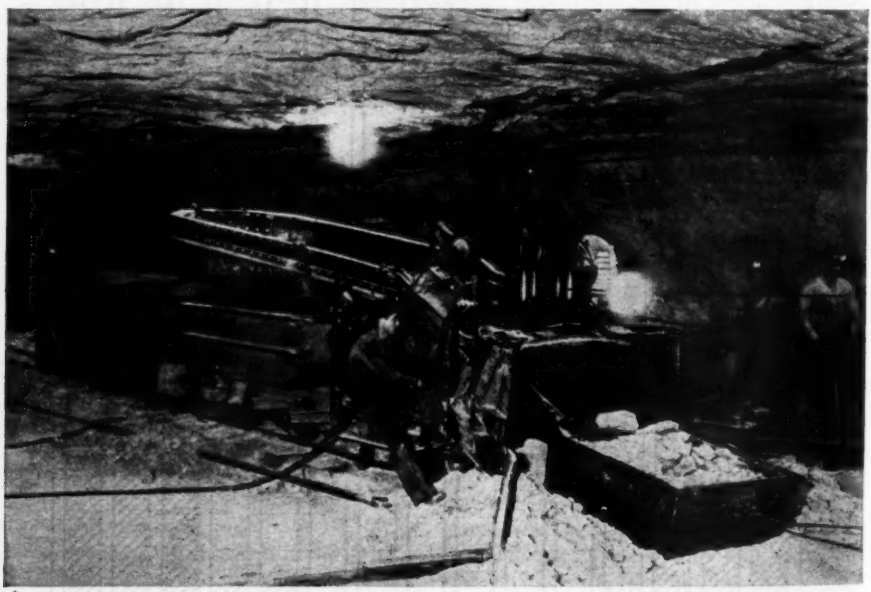

Fig. 1. Subsurface view of Mines of the U. S. Potash Company, Carlsbad, New Mexico.

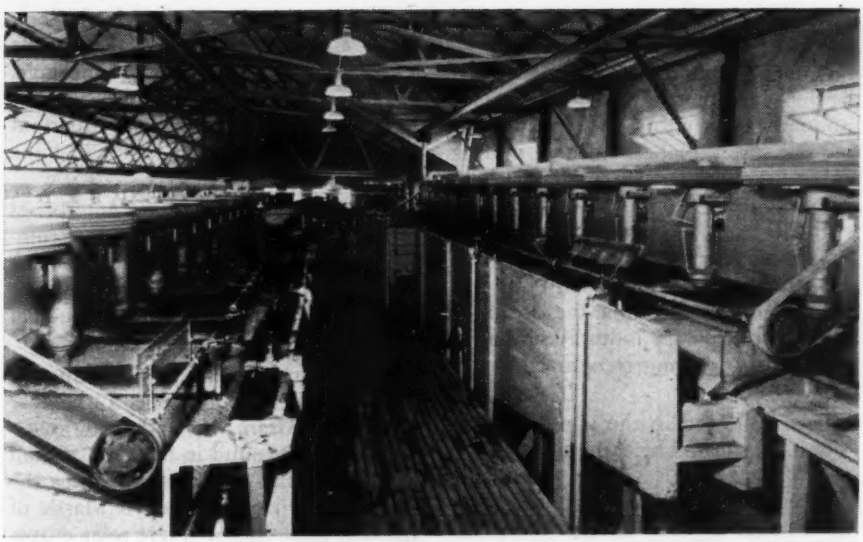

Fig. 2. Concentrating raw potash by flotation process in Potash Company of America plant, Carlsbad, New Mexico.

at best, a bill was introduced in the Congress in 1924, "Authorizing Investigation by the United States Geological Survey to Determine Location and Extent of Potash Deposits in the United States," which by dint of much perseverance on the part of its proponents and after drastic amendments including the designation of the U. S. Bureau of Mines as a participating agency, became law in 1926.

Under this authorization between 1926 and 1931, 24 core tests were drilled, 10 in Texas, 13 in New Mexico, and 1 in Utah. Beds of potash salts described as "of possible commercial interest" were encountered at depths of from 373 to 2,737 feet, varying in thickness from 1 ft. 6 in. to 8 ft. 10 in. and in potash content of from 9.12 to 13.94 per cent K_2O.

The drilling procedure made use of the plunger type of drill through the overlying rock strata until the saline strata were encountered, whereupon the diamond core drill was substituted. With the use of saturated saline solutions as lubricants, complete cores of the saline strata were recovered and their content of potash minerals identified and analyzed. This activity and the related publicity which preceded it alerted the oil-drillers exploring for oil in the Permian Basin to the possibility of discovering potash deposits and taught the technique of identifying such deposits if encountered.

Accordingly and concurrently the Snowden and McSweeney Oil Company exploring for oil in the neighborhood of Carlsbad in Eddy County of southeast New Mexico discovered a potash deposit as the result of the first core test for potash beginning April 14, 1926. This deposit proved of such richness and thickness and at a depth of only 1,000 feet as to leave no doubt as to its entire commercial value—a deposit which with further exploration to determine its lateral dimensions was recognized as equal to the best of the European deposits. Among the several strata of water-soluble potash minerals penetrated was the bed of sylvinite (a natural mixture of sylvite, potassium chloride, and halite, sodium chloride) containing 21% K_2O, which was destined to become the major source of potash for American agriculture.

In the development of a potash in-

dustry based on this deposit, the United States Potash Company organized by the aforementioned oil company was the first to enter this field and with production beginning in 1931 became the American pioneer in the mining and refining of a raw material from such a source. Its mine was equipped with the latest mechanical devices and its refinery in accordance with the best technology then developed. Thus was realized for the first time the dream of an American potash industry similar to that of Europe, long recognized as the ideal.

Then followed in the same field the Potash Company of America (organized in 1931) with a mine thoroughly mechanized and a refinery built to apply the flotation process, the first industrial application of the familiar flotation principles to a water-soluble ore. This was followed in turn by the mine and refinery of the former Union Potash and Chemical Corporation, subsequently to be amalgamated with the International Minerals and Chemical Corporation, again with a mechanized mine and a refinery employing flotation methods in part at least.* Including the aforementioned American Potash and Chemical Corporation, these four companies remained the major factors of the American potash industry until 1952 when there occurred a major expansion in the potash industry in the Carlsbad area of New Mexico.

In that year the Duval Sulphur and Potash Company through the agency of the Duval Texas Sulphur Company came into production with a new mine and refinery based on a potash deposit which after a thorough exploration by core-drilling methods was revealed as an important extension of the potash reserves of that potash-rich area.

Likewise, in the same year the Southwest Potash Corporation through the agency of the American Metal Company, Limited, developed their mine and refinery to the production stage, again based on a deposit which likewise has been established as an important extension of the potash reserves of the Carlsbad area.

Thus, with these two new enterprises in production there are now five companies operating in that section of New Mexico with properties valued at some $80,000,000 and a crude ore production of 7,000,000 tons.

Intermediate in scale of production is the plant of Bonneville, Ltd., near Wendover, Utah, where the raw material is a brine found in the clay stratum underlying the salt crust covering the Bonneville Flats or Salduro Marsh of the Salt Lake Basin. Here solar evaporation is employed to yield a mixture of crystalline potassium and sodium chlorides, subsequently separated by flotation.

In more recent years, the Dow Chemical Company of Midland, Michigan, has become a minor producer of high-grade potassium chloride as a by-product of its processes employing the natural brines of that State as the raw material.

And further exploration continues, notably in southeast New Mexico. Among others, the International Minerals and Chemical Corporation is conducting operations preliminary to the prospective development of a new potash deposit in Lea County, to the east of the present area of major operations. The Freeport Sulfur Company is actively appraising an ore body which it has discovered closer to Carlsbad. Also, much interest and publicity relate to the potash deposits of western Canada.

While steadily increasing their capacities and efficiencies in operations, with heavy capital expenditures, the major producers have added other chemicals to their list of products and thus have effected a diversification and full utilization of the constituents of their raw materials. Outstanding in

* The operations of these four potash production units including their processes are described in detail in the book, "Potash In North America" (Reinhold Publishing Company, 330 West 42nd Street, New York 18, N. Y.).

this respect is the American Potash and Chemical Corporation with a list of products that includes potassium chloride of some 98% purity designed for the fertilizer trade and a product further refined for the chemical trade, as well as potassium sulfate, sodium sulfate, sodium carbonate, sodium borate decahydrate, sodium metaborate, boric acid, bromine, potassium, sodium, and ammonium bromides, and lithium salts.

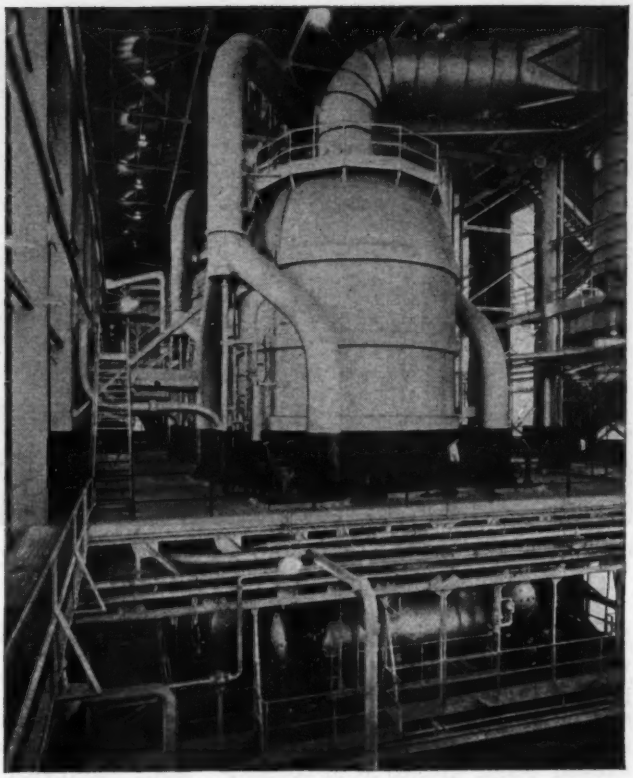

Fig. 3. Evaporator unit in the plant of the American Potash and Chemical Corporation's plant on Searles Lake, California.

The potash ores of the Carlsbad area are too free from impurities to admit of such an array of products; yet under production are potassium chloride of several degrees of purity and crystal size, 60% muriate, 50% muriate, and 22% run-of-mine salts, potassium sulfate, sulfate of potash-magnesia, magnesium oxide, and hydrochloric acid.

In tracing the development of the American potash industry, mention of an occurrence of 1935 may be warranted. The industry by then had reached those production levels where it felt itself justified in participating in the scientific research and educational activities long supported by the potash importers with enviable success. Accordingly, in that year the American Potash Institute was organized with an experienced staff designed to conduct the agronomic, editorial, chemical, and economic purposes and activities in the agricultural field for which it was organized,—namely, consumer service in the scientific and therefore profitable use of potash in crop production. To this end, supported by the American Potash and Chemical Corporation, the Potash Company of America, and the United States Potash Company, and in 1953 joined by the Southwest Potash Corporation and the Duval Sulphur and Potash Company, there are maintained research fellowships in the leading agricultural research centers of the Continent, and headed by the agronomic journal, "Better Crops With Plant Food," there is disseminated a large volume and diversity of educational literature dealing with the many aspects of the profitable use of potash in agriculture.

With these developments, the advent of World War II in 1939 found the

Fig. 4. This aerial view shows the refinery and storage facilities at the mine of the Southwest Potash Corporation near Carlsbad, New Mexico.

Nation in a radically different situation with respect to potash supplies as compared to that former situation of critical and near-disastrous dearth of supplies in 1914. On the later occasion the interested public greeted with considerable skepticism the announcement that the American potash industry was then prepared to take care of the Nation's potash requirements, for it was known that up to September of that year we still had been importing a considerable percentage of our potash requirements. What was not so generally known was that we had been exporting a substantial proportion of our production, which could and would be diverted back immediately into the domestic market; that we had large expansions in production capacity under way; that we had great reserves of unrefined run-of-mine salts readily available to equal any deficit in the refined salts that might develop; and that production of potassium sulfate, formerly largely imported, could and would be promptly expanded.

As recently as 1938 we still imported 65,000 long tons of potassium sulfate from Europe. At that time we already had some production from the interaction of potassium chloride and sulfuric acid. This conversion was promoted by the Potash Company of America in collaboration with producers of salt cake, potassium chloride being substituted for sodium chloride in that process. Later the American Potash and Chemical Corporation entered upon this production through the interaction of potassium chloride and burkeite, another practical application of the phase rule. In 1939 this company announced its willingness to expand initial production to provide the essential requirements of agriculture, and proceeded to do so. This was followed in short order by the completion of the refinery of the International Minerals and Chemical Corporation with the production of potassium sulfate from langbeinite (a natural potassium-magnesium sulfate) by interaction with potassium chloride. As the result of these activities, keen apprehension as to the adequacy of wartime supplies of this form of potash so essential in the growing of quality tobacco promptly subsided.

Likewise, the interruption of European exports deprived us of our accustomed source of agricultural water-

Fig. 5. An airplane view of the hoisting shaft, refinery, and storage building of the Duval Sulphur and Potash Company near Carlsbad, New Mexico.

soluble "magnesia" and magnesium sulfate and sulfate of potash-magnesia, both of German origin. This situation was adjusted by the last-named company in production of "washed langbeinite," an acceptable substitute for the formerly popular sulfate of potash-magnesia.

As the war progressed, drew to a victorious close, and the Nation entered upon its reconstruction period of ever-increasing demand for agricultural products, calling for more and more potash wherewith to grow them, there was no let-up in the potash industry's efforts to meet the requirements. Thus from an output of 535,000 tons of potash salts, equivalent to 317,000 tons K_2O in 1938, the last normal prewar year, production has increased, now reaching a volume allowing a total of North American deliveries during the calendar year of 1952 of 3,118,489 tons of salts, containing an equivalent of 1,796,258 tons K_2O. (See Chart.) This potash was produced on an ever-expanding scale under the many wartime handicaps that confronted the production industries in general but without the special Federal dispensations of capital and other aids so liberally provided other industries whose products were regarded as intimately tied in with the war effort. The chart, therefore, presents a picture of performance and of voluntary response to a national demand.

Superimposed was the task, voluntarily assumed by the producers, of supplying Canada with its requirements on terms of exact equality with our own. Added thereto were the requirements of Puerto Rico and Hawaii, of course, Cuba and the "good neighbors" to the south of us. Even "lend-lease" came to us for its quota.

Then the chemical industries, in 1938 consuming some 14,903 tons K_2O in their numerous manufactures, under the impetus of wartime demands had increased their estimated requirements to 100,000 tons K_2O by the war's end, dropping back to a peace-time requirement of 86,400 tons K_2O in 1952.

This outstanding achievement in increasing the Nation's supply of potash compounds was accomplished by a decrease in the wholesale price of the 60% K_2O grade of potassium chloride (muriate), which constitutes some 84%

of the total.

Prior to 1947 potash prices were quoted "C.I.F. Atlantic and Gulf Ports," a basis established by the importers. Since that year they have been quoted F.O.B. point of origin, i.e., the refineries where produced. To promote monthly as contrasted to seasonal deliveries, sales contracts made in June stipulate a 16% discount from the list price. Naturally advantage of this is taken pretty generally by the purchaser.

On the old C.I.F. basis of 1910-14, the price of muriate was 71.4 cents per unit K_2O. By 1946, this price, with the 12% discount applied, had been reduced to 47.1 cents, a reduction of 24.3 cents per unit K_2O. On the tonnage basis, the 1914 price of $35 per ton for 50% muriate is in striking contrast to the 1946 price of $28.26 per ton for 60% muriate.

In 1914, low-grade potash salts made up the bulk of imports, the 50% grade of muriate being the maximum concentration but only a small percentage of the total. The domestic industry early in its development applied refining techniques which made the 60% grade of muriate the standard product, with the drastic reduction in the lower grades. Thus by 1952, 60% muriate constituted 84% of the K_2O delivered for agricultural purposes.

This increase in concentration has no little economic significance in terms of a decrease in transportation charges per unit K_2O, even an increase from 50% to 60% K_2O. Thus with an average primary freight charge of $15 per ton from the potash refineries to the fertilizer mixing plants for retail distribution, the 60% grade represents a saving in freight of some five cents per unit K_2O as compared to the 50% grade.

Thus, on the basis of the production and price records, it would appear that the claim is justified that the American potash industry has shown its entire competence to meet all of the Nation's more essential needs for potash salts for the agricultural and chemical industries, during not only the critical period of World War II but also subsequent years.

The distribution of the 1952 output of potash salts is shown in the tabulation of Table I together with that of 1951 introduced for the sake of comparison.

With reference to potash importations from Europe, it was expected that they would reappear with the progress of reconstruction in the European areas of production. For the total of North American potash supplies shown in Table I there should be added imports of 212,000 tons K_2O in 1952 and 325,000 tons K_2O in 1951. The item "Other Exports" relates to shipments to countries other than those mentioned in the title of the above tabulation. Since potash prices in the United States are the lowest of all world markets, it is apparent that only unsold surpluses abroad, which do not exist, or the quest of dollar credits here would be a sufficient incentive for exports to this country in any great volume.

As to the distribution of the American output within the Continental United States, during 1952 potash salts were distributed by the primary producers to 44 states and the District of Columbia, which may be taken as the prevailing pattern. In that year Illinois and Ohio led with receipts of over 155,000 tons K_2O each, followed in order by Georgia, Indiana, Virginia, Florida, and North Carolina, each exceeding 90,000 tons K_2O in receipts. State deliveries, however, cannot be taken as synonymous with state consumption, for the following reasons: Currently, potash salts are sold wholesale and in car lots to the fertilizer mixing industry which functions as the retail agency distributing the potash to the ultimate consumer, the farmer, principally as a constituent of mixed goods, some 95% of the total being so distributed. From the larger mixing plants, the products frequently are shipped across state borders into neighboring and sometimes quite distant

TABLE I.—NORTH AMERICAN DELIVERIES OF DOMESTIC POTASH SALTS FOR THE CALENDAR YEARS, 1952 AND 1951*

Short Tons K_2O

Destination	1952		1951	
Agricultural				
United States	1,419,602		1,208,214	
Canada	42,524		44,063	
Cuba	4,580		6,317	
Puerto Rico	10,798		9,901	
Hawaii	16,451		14,214	
Other Exports	4,302		12,270	
Total Agricultural		1,498,257		1,294,979
Chemical				
United States	85,707		86,915	
Canada	734		514	
Total Chemical		86,441		87,429
Grand Total		1,584,698		1,382,408

* The American Potash Institute has for distribution on request a more comprehensive summary of potash statistics E-116 entitled, "Some Statistics of the American Potash Industry" by the present author.

states where the potash contained therein finds its ultimate consumption in the fertilization of crops. In such situations, therefore, state consumption may vary widely from state deliveries.

These mixtures, commercial fertilizers, as is well known, are carriers principally of the major crop nutrients, compounds of nitrogen, phosphorus, and potassium, to which frequently are added the minor, but still essential, nutrients such as magnesium, boron, and others. These mixtures are compounded in various ratios as determined by such factors as crop requirements as indicated by official state recommendations, the nutritive status of the soils on which grown (as determined by soil tests), the availability of supplies, and in too many situations habit and tradition. Under this system the potash content may vary from 0 to 30% K_2O.

Yet, despite the record of production and distribution, as herein related, there are potash demands that remain unfilled, articulate from those who want more and silence from those who have enough, providing no basis whatever for gauging the dimensions of any deficit in supply. Surprise that the market has increased as it has in view of the increased production that has taken place is frequently expressed.

Several factors are responsible. Foremost is the phenomenal increase in gross farm income, in 1948 reaching the record total of $31 billion. To provide contrast, this is to be compared to the gross farm income of $9.4 billion in 1938.

With incomes of such dimensions in recent years, resulting from the increasing demands and sustained high prices for farm products since the beginning of World War II, the farmer has had funds wherewith to purchase plant-food material more nearly in the quantities and of the grades he has been taught to use by his agronomic advisers.

It is a matter of statistical record that the farmer's expenditures for fertilizers rise and fall with his income and in a close ratio thereto, which is to say that he habitually spends for fertilizers so many cents out of each

Fig. 6. Heavy equipment for removing potash salts from large stock piles in storage, American Potash and Chemical Corporation's plant on Searles Lake, California.

dollar of income, varying widely between agricultural areas. To illustrate, during 1950 farmers in the states listed below spent the following proportions of their gross cash income from crops and government payments, in units per dollar, in the purchase of fertilizers:

Massachusetts	8.2
Pennsylvania	14.5
North Carolina	13.6
South Carolina	17.7
Ohio	12.5
Indiana	12.0
Iowa	3.2
Missouri	6.6
Minnesota	3.0
Kansas	2.0
Texas	1.9
California	4.5

In recognition of this economic rule other segments of the fertilizer industry, notably the phosphate producers, have greatly expanded their output and have applied an increased percentage of that output to the preparation of mixed goods for which, of course, potash is needed.

Thus education has become a further important factor accounting for this phenomenal increase in potash consumption—education based on research and field demonstration imparted to the farmer by many zealous Federal and state agricultural agencies.

Among the most effective educational devices has been the widespread adoption of diagnostic techniques for determining the fertility status of soils and the nutritional status of the crops growing thereon. Principal among these are the soil tests provided largely by state laboratories to which farmers can send their soil samples for analysis. These reveal the presence, or more frequently the absence, of potash in adequate supply in forms available for crop nutrition, thus providing authentic information for the farmer's guidance.

Related thereto is our growing knowledge of what constitutes the balanced nutrition of the major crops. In applying this knowledge as a diagnostic technique, the crop is "sampled" by the collection of leaves or other parts which are analyzed for their plant-food content. This procedure is resulting, with respect to potash, in the establishment of the so-called "critical levels" of potash content characteristic of the respective crops below which potash deficiency is indicated as determined by crop yields.

Contributing also to this increase in potash consumption has been the changing pattern of American agriculture. The great expansion of interest in soil conservation and in the adoption of the various practices that enter into that fundamentally important program have

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Pecan Variety Performance Before and After Orchard Was Grazed

By J. H. Hunter

Soil Scientist, U. S. Pecan Field Station, Albany, Georgia

CHANGES in the economic importance of various crops from a cash-income-producing standpoint brought about by the second World War made pecan growing less attractive and livestock raising more attractive than in the previous years. Before this happened there was some grazing in pecan orchards, but the greater portion of the orchards were managed without much emphasis on the income that could be derived from grazing livestock in them.

After producers began to receive high prices for livestock, more orchards were changed to some system of grazing. Information as to how these changed practices influenced the long-time trend of pecan nut production has not been available.

In 1946 a block of pecan trees previously managed by the then conventional practice of growing winter legumes, turning them into the soil in the spring, and cultivating during the summer was changed to the practice of grazing in both winter and summer.

Fig. 1. Third-year stand of reseeding crimson clover being grazed in a pecan orchard fertilized annually with either 0-14-10 or 0-20-20 fertilizer at a rate which supplied 40 to 50 pounds per acre of P_2O_5 and of K_2O. Because of the shade provided by the trees in the fall, new stands of this clover often survive dry weather better in orchards than in open fields.

Fig. 2. First-year stand of rye, vetch, and reseeding crimson clover furnishing an abundance of grazing. The forage plants were fertilized at seeding with 600 pounds of 6-8-6 fertilizer per acre and topdressed with 150 pounds of ammonium nitrate per acre. To establish clover this way it is best to seed it in a separate operation just after rye and vetch are seeded.

The present report gives a comparison of the performance of three varieties of pecan for two six-year periods, one prior to the change and the other afterward.

History from 1921 to 1945

The block of pecan trees involved in the study is located in a large orchard planted in 1921. The trees were set at a distance of 33 feet in the row and 66 feet between rows, thus making 20 trees per acre. The varieties were alternated in rows in such a way that no two rows of the same variety were adjacent. Fertilizer experiments were started with the Schley variety in 1926, the Moore in 1935, and the Stuart in 1938. By 1936 difficulty was experienced in controlling scab on the Schley variety; so every other tree in the row was removed. The stand of Stuart trees was thinned in 1938, and that of the Moore trees in 1945. However, the Moore trees had the advantage of having the stand of trees in the adjacent rows thinned during most of the time that records were kept on them.

The orchard is located on Greenville sandy loam which responds readily to good care. This soil is well-drained, but because the subsoil contains a relatively large amount of clay, it has the capacity to store considerable moisture. For the same reason it does not readily give up moisture to plants during periods of drought. For the most part, the plan of soil management followed from 1926 to 1945 was seeding winter cover crops, mostly legumes which were turned into the soil in the spring, and cultivation in the summer.

Responses to various treatments during the experimental period were not sufficiently outstanding to show important differences between the fertilizers applied. The only differences of importance were obtained between trees receiving no fertilizer and those receiving fertilizers.

Revised Plan

Beginning in the fall of 1945, the block was seeded to small grain and vetch for grazing and in the summer Bermuda grass, which was already established in the orchard, was allowed to form a sod for summer grazing. For

Fig. 3. Summertime scene in the orchard shown in Figure 2. Animals like shade and have been noted actively grazing during the heat of the day when no shade was found in the open fields. Note the stumps which show that the stand of trees in this orchard has been thinned recently. The use of widely spaced trees and the grazing of livestock give the grower a more dependable income from pecan orchards.

the next three years this same practice was followed, but in the fall of 1949 reseeding crimson clover was seeded in place of small grain and vetch. The clover was protected from overgrazing at time of flowering and seed formation and thus it has reseeded itself since 1949. The only cultivation given the orchard was that necessary to prepare the seedbed for the fall crops and to prepare the land for harvesting.

Different fertilizer treatments were continued on groups of trees of each variety, but as in the earlier period when cultivation was practiced, no outstanding difference in tree response was noted. However, in order to eliminate any chance of this being a factor in the data presented, groups of trees of each variety which had received approximately the same amount and kind of fertilizers during the period were selected. The numbers of trees of each variety thus selected for compiling these data were 30, 48, and 20 for the Moore, Schley, and Stuart varieties, respectively.

Recommended spray schedules were followed for protecting the crops from losses caused by diseases and insects. The Moore variety became susceptible to scab in 1948 and the trees were sprayed from then through 1951.

The mean annual rainfall at Albany, Georgia, is 49.5 inches. The location of the experimental pecan orchard is approximately 11 miles from Albany. The mean annual rainfall recorded in the orchard for the two six-year periods, 1940-1945 and 1946-1951, was 46.6 and 47.8 inches, respectively. In the first period, there were three years when the rainfall was slightly above normal and three years when it was below normal. In the second period, there were two years when the rainfall was considerably above normal and four years when it was below normal. Thus, the total rainfall for the two periods was very close to the same and the distribution was somewhat similar.

Tree Growth and Yield

The data on tree growth and yield were condensed into a simple summary, Table I, so that the comparisons for the

TABLE I.—INCREASES IN CROSS-SECTIONAL AREA OF TRUNKS OF PECAN TREES, YIELDS OF NUTS PER TREE, AND POUNDS OF NUTS PRODUCED PER UNIT INCREASE IN TRUNK AREA

Variety	Period and cultural practice	Mean annual increase in cross-sectional area of tree trunks	Mean annual yield of nuts	Mean pounds of nuts per unit of cross-sectional area increase
		Sq. In.	Pounds	
Stuart.....	1940–45, inc. (cultivation)	13.7	26	1.9
	1946–51, inc. (grazing)	17.2	49	2.8
Moore.....	1940–45, inc.[1] (cultivation)	13.7	49	3.6
	1946–51, inc. (grazing)	16.2	75	4.6
Schley.....	1940–45, inc.[2] (cultivation)	12.2	(2)	(2)
	1946–51, inc. (grazing)	19.6	31	1.6

[1] The Moore variety became susceptible to scab in 1948 and the trees were sprayed from then to 1951.
[2] The Schley trees were not sprayed during this period and, therefore, did not produce any nuts. A spray program was followed during the second period.

two periods could be readily comprehended. The data on tree growth are expressed in terms of mean annual increase in square inches in the cross-sectional area of the tree trunks and those for yields as the mean annual production of nuts in pounds per tree. In the last column, the relation of the growth to yield is expressed in terms of the number of pounds of nuts produced annually for each square-inch increase in the area of the tree trunks.

Examining first the comparative growth rates for the two periods, one will note that the trees of each of the three varieties increased in cross-sectional area at a higher rate during the second six-year period than during the first. During the second six-year period the trees of the Schley variety made by far the most rapid increase in cross-sectional area of the trunks, while those of the Moore variety made the least. The trees of the Stuart variety made slightly more growth than those of the Moore despite the fact that the stand of the latter trees had just been thinned and might have been expected to increase in growth rate proportionately more than the Stuart, which had the stand thinned several years earlier. It is believed that the relatively low increase in growth shown for the Schley variety for the first six-year period as compared with that for the Moore and that for the Stuart was due to the deterioration of the foliage because of disease during the years when no spray applications were made. It is of interest that growth rate has not been affected adversely by stopping summer cultivation.

In the comparison of yields it will be noted that both the Stuart and the Moore variety produced considerably higher yields in the second period than in the first. The relative increase for the Stuart was greater than for the Moore although the latter outproduced

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Alfalfa Seed Production In Alabama as Affected By Various Treatments[1]

By W. E. Knight[2]

State College, Mississippi

ALFALFA, *Medicago sativa,* has become a promising forage crop in Alabama in recent years. There were approximately 2,500 acres of alfalfa in the State in 1940 as compared to an estimated 58,760 in 1950. The current stands have been established from seed supplied by western states. Until recently, seed supplies have been short, resulting in high seed costs.

The present investigation was initiated to determine if alfalfa seed can be produced in Alabama by applying the improved methods of alfalfa fertilization developed in recent years by the Alabama Agricultural Experiment Station. The specific objectives were to compare the effects on alfalfa seed and forage yields of (a) various rates and combinations of lime and borax and (b) row versus broadcast seedings.

Review of Literature

Within the past decade numerous reports have appeared in the literature concerning the beneficial effect of boron in the production of a wide range of crops. A review of some of these important investigations has recently been published by Berger (1). Midgley (8) reported outstanding responses of alfalfa to applications of borax. Yields of hay were nearly doubled and seed yields were increased 35 times. At the North Carolina Agricultural Experiment Station, Piland et al. (9) found that the application of borax to alfalfa produced substantial increases of both hay and seed. From the Virginia Experiment Station, Grizzard and Matthews (6) reported that borax applied at the rate of 15 pounds per acre increased yields of alfalfa hay from 298 to 793 pounds per acre and increased seed yields from 82 to 184 pounds per acre. Results of Colwell's (3) experiments at Cornell show that borax applied at the rate of 30 pounds produced an increase in yield of 1,500 pounds of alfalfa hay and 70 pounds of seed from single cuttings. Dunklee and Midgley (5) applied from 30 to 40 pounds of borax per acre to alfalfa and obtained higher yields of hay and seed. Leaf yellowing did not occur where borax was applied and this treatment prolonged the stand and increased the production of protein. Rogers (10) found a wide variation in the response and tolerance of legumes to boron even when grown on light-textured soil. Austrian winter peas, blue lupine, soy-

[1] Contribution from the Department of Agronomy and Soils, Alabama Agricultural Experiment Station, Auburn, Alabama. Published with the approval of the Director. Part of a thesis submitted in partial fulfillment of the requirements of the degree of Master of Science and supported in part by a grant of funds from the Pacific Coast Borax Company.

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beans, alyce clover, peanuts, and sericea did not respond to borax on soils that were highly deficient in boron for alfalfa and crimson clover. Severe injury to stands of Austrian winter peas, crimson clover, red clover, and white clover was reported on sandy soils from the application of 15 pounds of borax per acre at time of seeding these legumes. Soybeans and sericea also showed low tolerance for borax. It was concluded that 8 to 10 pounds per acre of borax uniformly distributed broadcast will not injure seriously any of the legumes needing additions of boron.

Davis (4) studied the effect of liming on response to minor elements of crimson clover, soybeans, and alyce clover. Yields of alyce clover were reduced by boron or minor element treatments regardless of the lime applications. Crimson clover seed yields were increased from 90 pounds of seed per acre without borax to 850 pounds per acre when borax was applied.

Carlson and Stewart (2) found that row seedings produced one-third more seed per acre than drilled seedings. In general, thin seedings produced more seed than normal rates of planting.

Materials and Methods

Kansas common alfalfa was established on Norfolk loamy sand at Auburn, Alabama, in the fall of 1946. The alfalfa was seeded broadcast at the rate of 25 pounds of seed per acre and in 30-inch rows at the rate of 10 pounds per acre. Six fertilizer treatments were applied to the two methods of planting with three replications of each treatment. Six hundred pounds of 18 per cent superphosphate and 300 pounds of 60 per cent muriate of potash were applied to each plot before planting and in annual applications each spring thereafter. Ground dolomitic limestone was applied two weeks before planting at the rate of one ton and two tons per acre. Initial borax applications were 0, 20, and 30 pounds per acre with annual applications of 0, 10, and 15 pounds per acre. Manganese, zinc, and copper were included in one treatment in addition to borax.

The first growth of the season was cut for hay and the second growth was harvested for seed. Sufficient growth was produced for another harvest of hay following the seed crop. This growth was allowed to mature in 1947 to observe fall seed production. In 1948, the growth of alfalfa following the seed harvest was cut for hay.

Seed was harvested by mowing the alfalfa when approximately two-thirds of the seed pods were brown or black. The alfalfa was cured in the swath and threshed, using a small grain thresher.

Results and Discussion

The yields of alfalfa seed are given in Table I. In 1947, the average yield of seed per acre on plots receiving 2,000 pounds per acre of ground limestone was 58 pounds. There was no further increase when the rate of lime was increased from 2,000 to 4,000 pounds. The yield of seed dropped from 173 to 137 pounds per acre when the borax application was increased from 20 to 30 pounds. This boron toxicity apparently was corrected by the addition of the minor elements, manganese, zinc, and copper. When these minor elements were added, the yield was increased from 137 to 192 pounds per acre.

The response to fertilizer treatments followed approximately the same pattern in 1948. Annual applications of 10 and 15 pounds of borax per acre did not produce any further increase in yields over the original applications of 20 and 30 pounds per acre. The seed yields were somewhat less than in 1947, but the ranking of the treatments was the same. A heavy loss of seed resulted from unfavorable weather which prevented harvest of the crop at the proper time. Much seed sprouted in the pods or were dehisced.

Differences in seed yields for methods of planting were greater in 1947. Broadcast plots averaged 164.7 pounds

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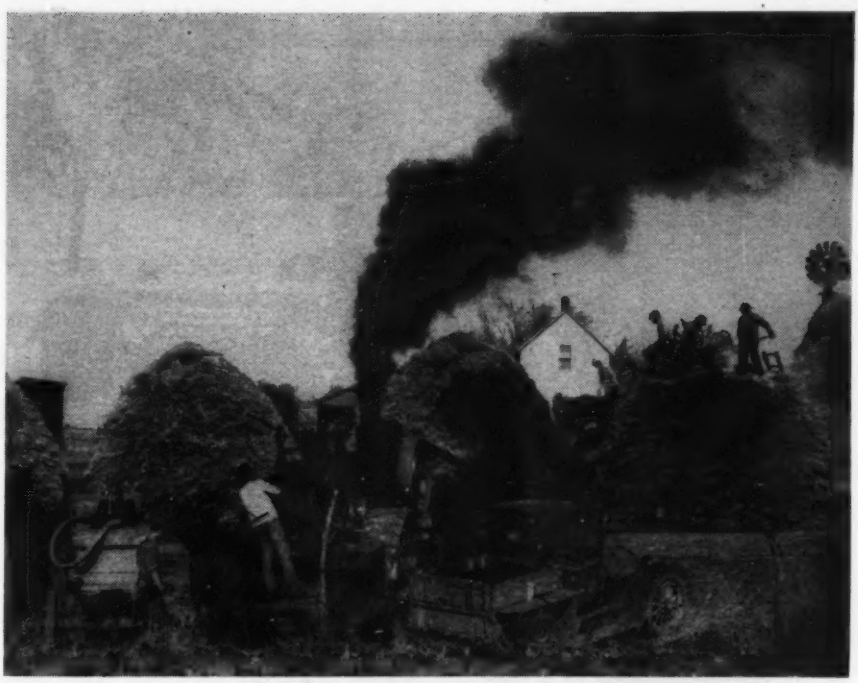
PICTORIAL

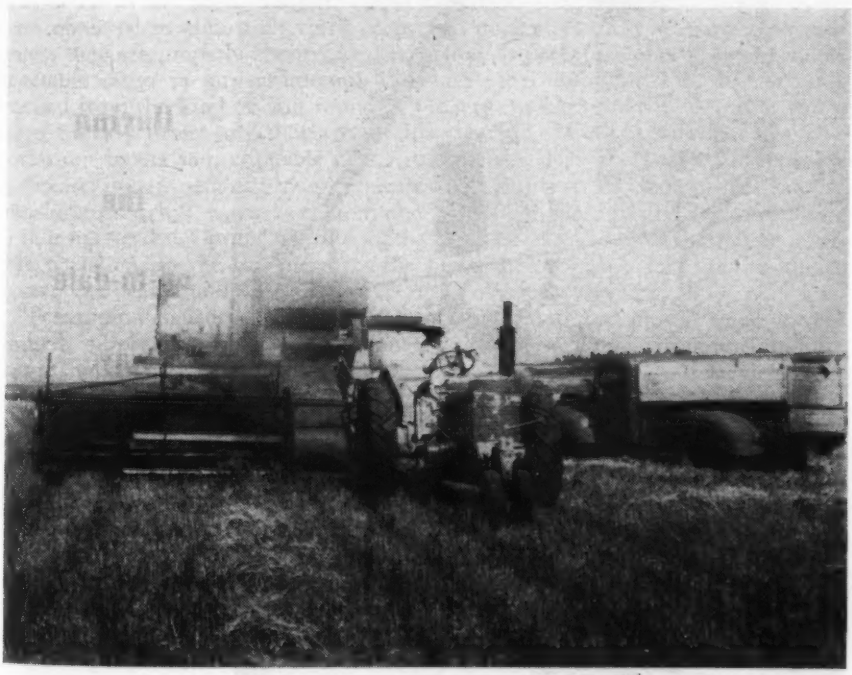
Reluctance!

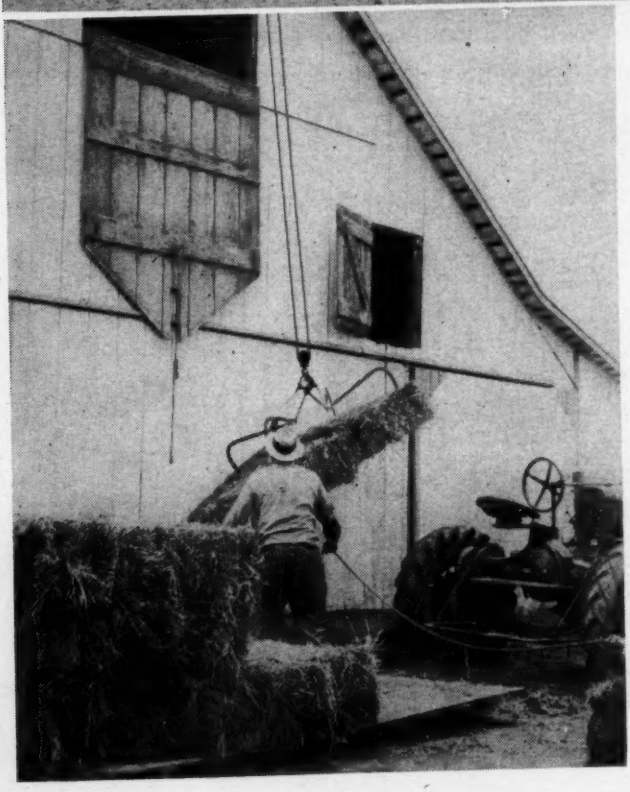
Above: Golden grain waves in the breeze.
Below: And the combines are rolling.



Above: Stack threshing required "man" power.

Below: Modern equipment spares neighbors.





Haying the up-to-date way.

The Editors Talk

Our Cover Picture

Cabbage is one of our universal vegetables in that it is grown in all sections of the United States and on all types of soils. Now commercially important because of its widespread use for salads, boiling, pickling, and sauerkraut, it came to this country with the early colonists in whose diet it undoubtedly was a cherished item. That it had been prized long before that is borne out by the fact that its use can be traced to 2,000 B. C. Cato, in 200 B. C., commented on its value as an appetizer if taken before a meal, as an accelerator of digestion when eaten during a meal, and as an incitement to thirst when taken afterwards.

Thompson of Cornell University in his book "Vegetable Crops" says, "Cabbage is a gross feeder, especially of nitrogen and potassium. It is considered a hard crop on the soil, and there is experimental evidence to substantiate this belief. Farmers often report that corn following cabbage produces a smaller yield than when it follows corn."

Supplementing this comment on the necessity of plenty of potash for cabbage, it is noted in the book "Hunger Signs in Crops" that potassium starvation has been observed in almost all truck crops and occurs generally in truck-crop soils unless they are properly fertilized. "Potassium is perhaps removed from soils by vegetable crops in larger amounts than are other nutrients, and it is readily leached from the kind of soils found in the large trucking areas. Most vegetable crops quickly reflect any shortage of this element. Without sufficient available potassium in the soil, vegetable plants suffer reduced vigor, greater susceptibility to disease, impairment of growth processes, and failure to develop normally and to translocate starch, i. e., move it from one part of the plant to another in response to internal needs. On the other hand, the presence of an adequate supply of available potassium in the soil promotes the health of the plant, increases resistance to certain diseases, and offsets the effect of an oversupply of nitrogen.

"Potassium-deficiency symptoms in vegetable plants are indicative of a very limited supply of available potassium in the soil. Early symptoms indicate danger, which may be avoided by applying potassium to the soil. If the deficiency is not corrected, the result may be defective plants, retarded growth, reduced yields, and economic loss.

"A deficiency of potassium is recognized by a change in the color of the vegetative parts as a whole and the occurrence of spots caused by a breaking down of the tissues. Symptoms may vary with the age of plants. In soils extremely low in potash the symptoms may appear in the seedling stage, but in those with a supply that is moderate but not sufficient to support normal growth to maturity they may not appear until the fruiting state. In soils with a medium content of potash and an abundant supply of nitrogen, potassium-deficiency symptoms may develop after a period of rapid growth.

"Cabbage plants showing potassium deficiency in its earliest stage become

bronzed on the border of the leaf, and the bronzing spreads inward. As the deficiency becomes acute, the symptoms progress and are manifested by a parching of the leaf rim and the development of brown spots in the interior of the leaf."

The cabbage in our cover illustration is in an early stage of potash deficiency. The plant-food needs of the crop over and above what the soil would supply should have been determined and the fertilizer applied before planting. However, when potash deficiency is detected or recognized at this stage, the crop usually will be benefited by a sidedressing of fertilizer containing potash. It is thus possible to remedy to a large extent a situation which if neglected can result in serious loss to the grower.

A New Record in Fertilizer Use

American farmers, gardeners, and lawn-keepers used an all-time record quantity of 22,432,418 tons of fertilizers in 1951-52, according to the 13th annual survey of fertilizer consumption in the United States and its territories (Hawaii, Puerto Rico, and Alaska), recently completed by the U. S. Department of Agriculture. The quantity used was 1,441,024 tons more than for the previous year.

Along with this increase in total tonnage, the report shows a continued increase in the nutrient content of mixed fertilizer. According to Walter Scholl and H. M. Wallace of the Bureau of Plant Industry, Soils, and Agricultural Engineering, who conducted the survey, the primary nutrient content average for all mixtures increased from 24.19 per cent in 1950-51 to 24.86 per cent in 1951-52 when it was comprised of nitrogen 4.30 per cent; available P_2O_5, 11.14 per cent; and K_2O, 9.42 per cent. These averages represent increases of 15.9, 7.3, and 39.6 per cent over their respective values in 1943-44.

Further evidence of higher analysis fertilizers is shown by the fact that although the quantity of all fertilizers containing primary nutrients increased 6.4 per cent over 1950-51, the total quantity of the primary nutrients contained in these fertilizers increased from 4,726,690 tons in 1950-51 to 5,205,623 tons in 1951-52, an increase of 478,933 tons or 10.1 per cent. All fertilizers in 1951-52 supplied in nitrogen 1,424,780 tons; available P_2O_5, 2,199,376 tons; and K_2O, 1,581,467 tons.

The report indicates that of all fertilizers used in 1951-52, about 60 per cent comprised N-P-K mixtures. Other mixtures and materials containing one or more of the primary plant-nutrient elements N,P,K, made up 36.5 per cent of the total while the remaining 3.5 per cent consisted of secondary and minor element materials containing no primary nutrients.

These annual surveys are of great value to agricultural advisers, research workers, the fertilizer trade, and all interested in agriculture. The use of fertilizer is one of the most important factors involved in conserving the fertility of our soils. Before this series of surveys was begun, reliable data for the country as a whole were not available. The figures now being compiled by the U. S. Department of Agriculture are performing a valuable service in showing interested parties what is being used and the trend in consumption practices in the various states of the country.

Let's remember—FARM SAFETY WEEK, July 19-25—the year round.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.2	163.0	306.0	168.0	211.0	19.50	69.30	....
1952									
June.....	38.02	44.0	310.0	436.0	173.0	206.0	17.05	61.90	....
July.....	37.02	42.0	274.0	446.0	173.0	198.0	17.25	71.00	....
August.....	37.92	48.8	278.0	410.0	173.0	204.0	19.35	69.80	....
September...	39.11	51.0	222.0	335.0	171.0	209.0	20.25	69.60	....
October.....	36.77	50.9	211.0	294.0	153.0	207.0	20.85	70.70	....
November...	34.05	47.6	217.0	311.0	145.0	213.0	21.25	69.70	....
December....	31.71	49.6	199.0	362.0	150.0	212.0	21.65	68.50	....
1953									
January.....	29.79	46.2	206.0	386.0	148.0	210.0	21.65	65.30	....
February....	30.19	36.7	179.0	384.0	143.0	205.0	20.85	64.50	....
March.....	31.52	....	165.0	401.0	146.0	210.0	19.65	63.60	....
April.....	31.45	....	134.0	409.0	146.0	208.0	18.85	63.10	....
May.....	31.73	51.5	115.0	413.0	149.0	206.0	17.95	61.80	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	459	184	244	193	213	139	192	201
1950.....	323	517	132	197	238	226	141	384	185
1951.....	306	512	233	349	262	239	164	307	239
1952									
June.....	307	440	445	497	269	233	144	275	250
July.....	299	420	393	508	269	224	145	315	287
August.....	306	488	399	467	269	231	163	310	229
September...	315	510	319	382	266	236	171	309	182
October.....	297	509	303	335	238	234	176	314	189
November...	275	476	311	354	226	241	179	309	238
December....	256	496	286	412	234	240	182	304	256
1953									
January.....	240	462	296	440	231	238	182	290	237
February....	243	367	257	437	223	232	176	286	237
March.....	254	...	237	457	227	238	166	282	248
April.....	254	...	192	466	227	235	159	280	204
May.....	256	515	165	470	232	233	151	274	182

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952						
June	3.34	2.07	14.27	11.28	8.38	8.38
July	3.34	2.07	14.26	11.28	8.19	7.59
August	3.34	2.07	14.26	11.28	9.78	7.89
September	3.34	2.07	13.39	11.25	11.11	10.02
October	3.34	2.07	13.39	11.24	10.62	9.41
November	3.34	2.07	13.31	11.24	10.32	9.71
December	3.34	2.26	13.20	11.24	9.95	9.17
1953						
January	3.34	2.28	13.25	11.24	8.43	8.05
February	3.34	2.28	13.21	11.24	7.75	7.28
March	3.34	2.28	12.69	11.24	7.16	6.56
April	3.34	2.28	11.75	11.24	6.07	6.00
May	3.34	2.28	10.34	11.24	6.23	6.14
	Index Numbers (1910-14 = 100)					
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952						
June	125	73	408	320	249	238
July	125	73	407	320	243	216
August	125	73	407	320	290	224
September	125	73	383	319	330	285
October	125	73	383	318	315	267
November	125	73	380	318	306	276
December	125	79	377	318	295	261
1953						
January	125	80	379	318	250	229
February	125	80	378	318	230	207
March	125	80	363	318	212	186
April	125	80	336	318	180	170
May	125	80	295	318	185	174

Wholesale Prices of Phosphates and Potash**

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952							
June	.860	3.98	5.47	.353	.708	13.44	.176
July	.860	3.98	5.47	.386	.768	14.72	.193
August	.860	3.98	5.47	.386	.768	14.72	.193
September	.860	3.98	5.47	.389	.768	14.72	.193
October	.860	3.98	5.47	.391	.768	14.72	.193
November	.860	3.98	5.47	.391	.768	14.72	.193
December	.860	3.98	5.47	.427	.827	16.00	.210
1953							
January	.860	3.98	5.47	.430	.827	16.00	.210
February	.860	3.98	5.47	.430	.827	16.00	.210
March	.860	4.22	5.47	.430	.827	16.00	.210
April	.860	4.28	....	.430	.827	16.00	.210
May	.860	4.28	....	.430	.827	16.00	.210
	Index Numbers (1910-14 = 100)						
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952							
June	160	110	112	65	74	56	80
July	160	110	112	70	81	61	82
August	160	110	112	70	81	61	82
September	160	110	112	70	81	61	82
October	160	110	112	70	81	61	82
November	160	110	112	70	81	61	82
December	160	110	112	75	87	66	85
1953							
January	160	110	112	76	87	66	85
February	160	110	112	76	87	66	85
March	160	117	112	76	87	66	85
April	160	119	...	76	87	66	85
May	160	119	...	76	87	66	85

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1927.....	141	148	139	116	89	150	100	94
1928.....	149	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	123	130	127	86	56	130	102	77
1942.....	158	149	144	93	57	161	112	77
1943.....	192	165	151	94	57	160	117	77
1944.....	196	174	152	96	57	174	120	76
1945.....	206	180	154	97	57	175	121	76
1946.....	234	197	177	107	62	240	125	75
1947.....	275	231	222	130	74	362	139	72
1948.....	285	250	241	134	89	314	143	70
1949.....	249	240	226	137	99	319	144	70
1950.....	256	246	236	132	89	314	142	72
1951.....	302	271	263	139	93	331	152	76
1952								
June.....	292	273	250	141	98	316	160	69
July.....	295	273	250	141	98	313	160	73
August....	295	274	252	144	98	337	160	73
September.	288	271	250	145	98	349	160	74
October...	282	269	248	145	98	341	160	74
November.	277	268	248	144	98	336	160	74
December..	269	267	246	146	101	329	160	79
1953								
January...	267	267	246	144	102	307	160	80
February..	263	264	246	142	102	296	160	80
March....	264	265	248	141	102	282	160	80
April.....	259	264	246	139	102	256	160	80
May.....	261	264	247	137	102	245	160	80

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only; manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers:

"Fertilizer Recommendations for Arizona, 1953," Agr. Ext. Serv., Univ. of Ariz., Tucson, Ariz., Cir. 208, Dec. 1952, H. E. Ray.

"Fertilizer Tests with Flue-Cured Tobacco," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 512, Jan. 1953, F. Clark.

"Commercial Fertilizers Inspected and Analyzed in the State of Georgia, Fall of 1951-Spring 1952," Ga. Dept. of Agr., Atlanta, Ga., Bul. 137, Jan. 1953, T. Linder.

"Nitrogen Top Dressing of Wheat in the Pocket Area in 20 Questions," Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Leaf. 351, Feb. 1953, H. R. Lathrope.

"Louisiana Fertilizer Report, 1951-1952," Agr. Exp. Sta., Baton Rouge, La., E. A. Epps.

"Commercial Fertilizers, 1952," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Off. Insp. 225, Oct. 1952, E. R. Tobey.

"Anhydrous Ammonia Comes to Minnesota," Agr. Ext. Serv., Univ. of Minn., St. Paul 1, Minn., Soil Series 37, Apr. 1953, H. E. Jones and A. C. Caldwell.

"Ohio Fertilizer Recommendations for 1953," Agr. Ext. Serv., Ohio State Univ., Wooster, Ohio, Ext. Bul. 338, March 1953, E. Jones.

"Higher Crop Yields with Lime, Fertilizers, and Legumes," Ext. Div., Okla. A & M College, Stillwater, Okla., Cir. 588, W. Chaffin.

"Effect of Plowing Under Legumes and Applications of Nitrogen on Yields of Cotton and Corn," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Prog. Rpt. 1521, Dec. 16, 1952, E. B. Reynolds and J. E. Roberts.

"Effect of Different Rates of Nitrogen Fertilizer on the Shipping Quality of Greenwrap Tomatoes," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Prog. Rpt. 1522, Dec. 19, 1952, H. B. Sorensen and L. S. Alley,

"Corn-Green Manure-Fertilizer Tests at Prairie View, 1950-52," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Prog. Rpt. 1528, Jan. 13, 1953, O. E. Smith and F. L. Fisher.

"Cotton Yields in El Paso Valley as Influenced by Time of Application of Ammonium Nitrate and Superphosphate, 1952," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Prog. Rpt. 1534, Jan. 26, 1953, P. D. Christensen and P. J. Lyerly.

Soils:

"The Nickel Content of Some Hawaiian Soils and Plants and the Relation of Nickel to Plant Growth," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii, Tech. Bul. 19, March 1953, A. T. Chang and G. D. Sherman.

"The Purdue Soil and Plant Tissue Tests," Agr. Exp. Sta., Lafayette, Ind., Sta. Bul. 584, Dec. 1952, A. J. Ohlrogge.

"Boron Deficiency in Indiana Soils," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Sta. Cir. 387, March 1953, S. A. Barber.

"Green Manure Crops for Soil Improvement in Iowa," Agr. Ext. Serv., Iowa State College, Ames, Iowa, Pam. 191, Jan. 1953, H. B. Cheney and M. A. Anderson.

"Save Our Soil," State Dept. of Education, Natchitoches, La., Bul. 743, June 1952, S. M. Jackson.

"The Minnesota Soil Testing Program," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Soil Series 32, May 1950, P. M. Burson.

"Crop Response to Irrigation in Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 180, March 1953.

"Correcting Soil Deficiencies for More and Better Forage from Permanent Pastures," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 582, June 1952, A. W. Klemme and W. A. Albrecht.

"Irrigation for Vegetable Crops," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 182, March 1953, J. A. Campbell.

"Save Our Soils," Agr. Ext. Serv., Okla. A & M College, Stillwater, Okla., Cir. 590.

"Land Capability for Soil and Water Conservation in Oregon," Agr. Exp. Sta., Corvallis, Oreg., Sta. Bul. 530, Jan. 1953, W. W. Hill and W. L. Powers.

"Irrigation on Pennsylvania Farms," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 562, Jan. 1953, W. L. Barr and D. W. Thomas.

"Soils of Day County, South Dakota," Agr. Exp. Sta., S. Dak. State College, Brookings, S. Dak., Bul. 421, May 1952, A. J. Klingelhoets, E. R. Lumb, and G. J. Buntley.

"How Soil Reaction Affects the Supply of Plant Nutrients," Agr. Ext. Serv., Va. Polytechnic Inst., Blacksburg, Va., Bul. 136, Rev. Jan. 1953.

"Drainage Investigation Methods for Irrigated Areas in Western United States," USDA, Wash., D. C., Tech. Bul. 1065, Sept. 1952, W. W. Donnan and G. B. Bradshaw.

"Farming Terraced Land," USDA, Wash., D. C., Leaf. 335, Nov. 1952, P. Jacobson and W. Weiss.

Crops:

"Southwest Arkansas Cotton Variety Test for 1952," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mim. Series 12, Feb. 1953, J. O. Ware and B. A. Waddle.

"East-Central Arkansas Cotton Variety Tests for 1952," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mim. Series 13, Feb. 1953, J. O. Ware and C. Hughes.

"Common Arizona Range Grasses—Their Description, Forage Value and Management," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 243, Nov. 1952, R. R. Humphrey, A. L. Brown, and A. C. Everson.

"Forage Production on Arizona Ranges—III Mohave County," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 244, Feb. 1953, R. R. Humphrey.

"Production of Dry Edible Lima Beans in California," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Cir. 423, March 1953, R. W. Allard.

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Alfalfa Seed Production . . .

(*From page* 22)

of seed per acre as compared to an average of 141.0 pounds for row seedings. In 1948, row planting produced an average of 101.5 pounds of seed per acre while broadcast seedings produced an average of 96.7 pounds. The results of this experiment favor broadcast over row seedings when the production of seed and hay are both considered. Row seedings were found to require more cultivation, to have a tendency for hay to be dirty, and to produce smaller hay yields than broadcast stands.

The effects of borax applications on alfalfa may be compared in Figure 1. Typical branches of alfalfa deficient in

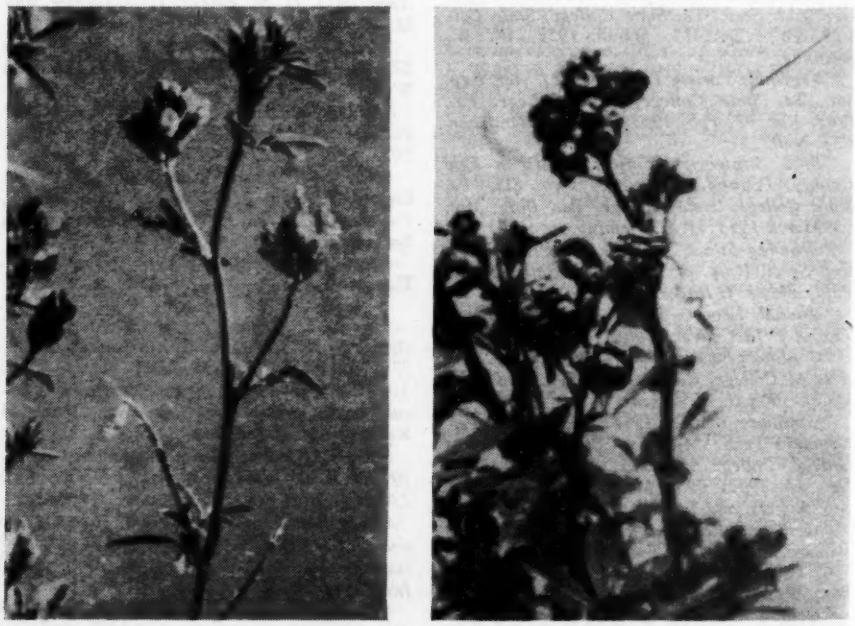

Fig. 1. Typical branches of alfalfa grown with and without application of borax. The branch on the left illustrates the stripped raceemes and absence of seed pods charactertistic of plants grown without boron. Branch at right shows setting of seed pods when boron was applied. (June 30, 1948)

TABLE I.—EFFECT OF LIME AND BORAX TREATMENTS AND METHOD OF PLANTING ON ALFALFA SEED YIELDS, AUBURN, ALABAMA, 1947 AND 1948

Lime and fertilizer treatment*	Time of application and rate per acre		Average seed yields per acre					
			July 30, 1947			July 14, 1948		
	Before planting	Annually	30" rows	Broadcast	Av. of row & broadcast seedings **	30" rows	Broadcast	Av. of row & broadcast seedings ***
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Lime	2,000	..	63	53	58	63	55	59
Lime	2,000	..	160	176	168	105	104	105
Borax	20	..	...	...	...	...	...	...
Lime	2,000	..	178	199	189	128	101	115
Borax	20	10	...	...	...	...	...	...
Lime	4,000	..	137	209	173	92	116	104
Borax	20	10	...	...	...	...	...	..
Lime	4,000	..	133	140	137	96	77	87
Borax	30	15	...	...	...	...	...	...
Lime	4,000	..	173	211	192	125	127	126
Borax	30	15	...	...	...	...	...	...
$CuSO_4$	10	..	...	...	...	...	...	...
$ZnSO_4$	10	..	...	...	...	...	...	...
$MnSO_4$	30	..	...	...	...	...	...	...
Method of planting Means			141.0	164.7		101.5	96.7	

* 600 lb. 18% superphosphate and 300 lb. muriate per acre at planting and annually to all plots.
** LSD = 38.7 at the 5% level.
*** LSD = 26.9 at the 5% level.

boron and alfalfa receiving adequate amounts of boron are shown. The boron-deficient branch of alfalfa illustrates typical stripping of florets, failure of seed set, and continued blossoming that were characteristic of the plants grown without applications of borax. In contrast, the alfalfa branch from a plot receiving borax is characterized by clusters of plump seed pods, the absence of blossoms, and the absence of stripped racemes. Boron-deficient alfalfa continued to bloom without setting seed until the seed were ready for harvest on the plots receiving borax.

The second growth of the season has been reported as best for alfalfa seed production in other areas (12). Observations of seed setting for two years indicate the second growth is also best for alfalfa seed production in Alabama. Alfalfa failed to set seed after July in 1947 and 1948.

Average alfalfa hay yields are presented in Table II. The fertilizer treatments did not cause any outstanding differences in yields of hay in 1947 or 1948.

Summary

A fertilizer and method of planting experiment was conducted on Norfolk loamy sand at Auburn, Alabama, to determine the effects on alfalfa seed production of (a) various rates and combinations of lime and borax and (b) row versus broadcast seedings.

TABLE II.—THE EFFECT OF LIME AND BORAX TREATMENTS AND METHOD OF PLANTING ON ALFALFA HAY YIELDS, AUBURN, ALABAMA, 1947 AND 1948 *

Lime and fertilizer treatment**	Time of application and rate per acre		Average hay yields per acre					
			1947			1948		
	Before planting	Annually	30" rows	Broadcast	Av. of row & broadcast seedings ***	30" rows	Broadcast	Av. of row & broadcast seedings ***
	Lb.	*Lb.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Lime	2,000	..	.60	1.14	.87	2.11	2.94	2.53
Lime	2,000	..	.58	1.27	.93	1.86	3.18	2.52
Borax	20	..	...	....	....	....	....	....
Lime	2,000	..	.64	1.13	.89	1.99	2.91	2.45
Borax	20	10	...	....	....	....	....	....
Lime	4,000	..	.51	1.50	1.01	1.78	3.40	2.59
Borax	20	10	...	....	....	....	....	....
Lime	4,000	..	.57	1.15	.86	1.74	2.55	2.15
Borax	30	15	...	....	....	....	....	....
Lime	4,000	..	.86	1.34	1.01	2.47	3.27	2.87
Borax	30	15	...	....	....	....	....	....
$CuSO_4$	10	..	...	....	....	....	....	....
$ZnSO_4$	10	..	...	....	....	....	....	....
$MnSO_4$	30	..	...	....	....	....	....	....
Method of planting Means			.63	1.26	....	2.00	3.04	....

* Hay was harvested May 5, 1947, April 22, 1948, and August 17, 1948.
** 600 lb. 18% superphosphate and 300 lb. 60% muriate per acre at planting and annually to all plots.
*** LSD for 1947, 0.15 at 5% level. LSD for 1948, 0.38 at 5% level.

Seed yields were more than doubled by applications of borax previous to planting. Hay yields were not significantly different during the two years the test was under way.

In 1947, 20 pounds of borax per acre applied at planting time with 10 pounds per acre applied annually thereafter increased seed yields from 58 to 189 pounds per acre. The same treatment in 1948 increased seed yields from 59 to 115 pounds of seed per acre.

The average yield of seed was increased from 137 to 192 pounds per acre when manganese, zinc, and copper were applied with 30 pounds of borax. The addition of these minor elements apparently corrected the toxic effect produced when 30 pounds of borax per acre were applied.

There was no evidence from this experiment that two tons of ground limestone changed the lime-boron relation enough to affect seed or hay yields significantly.

The methods of planting used in this experiment did not change seed yields appreciably. However, hay yields were considerably higher on broadcast plots.

In general, the second growth of the season was considered best for seed production.

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Pecan Variety Performance . . .

(*From page* 20)

the former. No nuts were produced by the Schley during the first period because the trees were not sprayed to control scab and consequently no crops were harvested. The production of nuts by the Schley variety during the second period was relatively low and this variety, therefore, does not show much promise at this location. The poor showing for this variety was due to a combination of factors. In 1948, it rained so much that scab control was not satisfactory and the crop was lost. In 1950, a large percentage of a very promising crop dropped during the summer, presumably as a result of changes in moisture conditions since no insect or disease could be identified as associated with the drop. The nuts dropped in a very few days following a rain which brought relief from a dry, hot period. This seems to be a weakness of the Schley variety. Although some drop of nuts from both the Moore and the Stuart variety occurred under the same conditions, the drop never reached damaging proportions.

In the second period an increase in the pounds of nuts produced per unit of growth increase is shown for both the Stuart and the Moore variety over that in the first period. This indicates that the trees were in better condition and able to produce heavier crops when grazed than when winter cover crops and summer cultivation were practiced. Other factors such as the effect of thinning the stand of trees may have entered into this performance, but even so, it is encouraging and indicates that well-managed grazing in pecan orchards can add to the income from the land and improve production of pecans at the same time.

Quality of Nuts

The standards used for measuring quality were not the same for the entire 12 years; therefore, direct, simple comparisons could not be made. However, the data collected for the Stuart and Moore varieties show that the nuts produced were somewhat smaller after grazing was started than when summer cultivation was practiced. Kernel quality varied from year to year throughout the period, the size of the crop supported by the trees being the major factor determining how well the kernels

developed. On the whole the quality of the kernels of the Moore and Stuart nuts during the second period was better than during the first. This is probably due to the fact the "on-year" yields did not contribute as much to the mean yields during the latter period and the "off-year" yields contributed more.

Summary

The comparative results from a block of pecan trees of three varieties (Stuart, Moore, and Schley) for two periods which involve changes in cultural practices are reported. In the first period, winter cover crops were grown and returned to the soil and the land was cultivated during the summer, while in the second period grazing crops were grown and no summer cultivation was practiced.

Tree growth of all three varieties as measured by increase in the cross-sectional area of the trunks was less when summer cultivation was practiced than when grazing was practiced. The yields of the Stuart and Moore varieties were considerably less when summer cultivation was practiced than when grazing was practiced, and the production of nuts per unit of cross-sectional area increase was greatest when grazing practices were followed. The nuts produced by the Moore and Stuart varieties were smaller during the years when grazing was practiced, but kernel development was equal if not superior to that when summer cultivation was practiced. No yields of the Schley variety of nuts were secured during the first period, and during the second period yields were much below those of the Moore and Stuart varieties.

It is concluded that the change to grazing practices in this orchard was desirable.

American Potash Industry . . .

(*From page* 16)

been conspicuous in this respect. Somewhat related thereto is the fertilized pasture, a revolutionary new development, particularly in the South where the potentialities of a livestock industry are being so widely demonstrated through actual practice. In addition, this program is being promoted there as an important phase of diversification to relieve dependence on cotton and the one-crop system which its growing so extensively represents. For the fertilized pasture, legume-grass mixtures are prescribed, with liberal applications of high-potash fertilizer grades. For grazing and hay the legumes are being increasingly grown with emphasis in the South on alfalfa where its successful growing has now been made possible with adequate high-potash fertilization, provided borax is included. High-potash mixtures are in great demand and when unobtainable create the impression of inadequate potash supplies.

Among the changing patterns mention should be made of the radical new practices in the growing of the corn crop, it now having been demonstrated that with greatly increased fertilization applied to the adaptable hybrids, closely planted, yields can be more than doubled over the averages obtained by the old practices.

In this new development increased applications of compounds of nitrogen are the major feature, although the balanced ratio of potash is likewise essential. With the prevailing high wages for farm labor, yields per acre take on added importance in determining farm profits, the adequate use of fertilizers to this end having been demonstrated as yielding a handsome profit on the money so invested.

Mention should be made likewise of the sensational new results in the development of chemical pesticides, enabling the farmer more effectively to resist the inroads of the multifarious organisms that infest his crops, reduce his yields, and thereby his profits. As a striking illustration of this changing pattern, mention need be made only of the phenomenal increase in cotton yields reported as resulting solely from the complete elimination of the boll-weevil. With the repetition and verification of these results, the conclusion is being drawn that once the boll-weevil hazard is eliminated, the cotton farmer can greatly increase his fertilizer applications on that crop with assurance of a profitable return on the investment.

All these and other phases of the changing pattern, while currently increasing his income, enhance the economic stability of the American farmer as a lasting result, rendering him less vulnerable to unfavorable changes in the economic pattern and by that route lending stability to the industries dependent upon him as the ultimate consumer of their products.

Ohio Can Boost Corn Yield

OHIO farmers can boost the State's average corn yield by at least 36 bushels an acre within the next 10 years. John Slipher, Soil Conservationist at Ohio State University, says the State could average 85 bushels of corn an acre. Present 10-year average yield is 49 bushels.

Individual yields would advance at the same time but at varying rates. An individual's present average yield and his diligence in applying seven practices are among factors that would cause the variation, according to Slipher.

Here are the practices and the average increase each would produce: Using the best hybrids available would add 3 bushels. Proper use of manure would boost corn yields another 4 bushels.

If every farmer grew enough of the right kind of sod crops, average corn yield would climb another 8 bushels. Leaving enough crop residue on land each year would add 3 bushels more.

Removing excess moisture from soil would increase yields 7 bushels. Five bushels would come from renewing and maintaining soil tilth. Adding more fertilizer would add another 6 bushels to average yields.

Leaf Analysis for Orchards

LEAF analyses, together with tree symptoms, are considered the best criteria for studying nutritional problems in deciduous orchards in California, according to Omund Lilleland, Pomologist on the Davis campus of the University of California.

"Leaf analyses have shown that fertilizers applied in the surface of the soil in some California orchards sometimes remain positionally unavailable and are not absorbed by the tree," Lilleland said.

This is one reason the leaf analysis

is favored for evaluating nutrient needs and disorders in deciduous orchards in California. Another reason is the greater convenience in sampling.

"Nitrogen, our commonest deficiency in California orchards, has not been explored by leaf analyses as thoroughly as some of the other elements, mainly because its deficiency symptoms are readily recognized, and the field trials quickly confirm these," said Lilleland. "The same may be said for zinc and possibly iron."

Leaf analyses have been helpful in establishing the potash, magnesium, and manganese status in many orchard fertilizer trials. Among the fruits which have been sampled by leaf analysis with good results are peaches, apricots, Japanese plums, and for nuts, almonds and English walnuts.

Wisconsin Is Losing Potash

WISCONSIN is steadily losing its supply of potash for plant food in farm lands, according to a University of Wisconsin soils specialist. C. J. Chapman reports that soil tests from around Wisconsin in 1952 show about 79 per cent of the tested land is short on potash. He points out that another plant food—phosphate—was the big problem in Badger State soils 25 years ago. But the situation is different now.

Chapman says increased alfalfa acreage is one big reason for potash loss. Alfalfa is a tremendous potash pump. Each ton of this legume takes more potash out of the soil than you put in with 200 pounds of 0-20-20 fertilizer. Of course, some of that potash goes back to the fields in manure when all the feed goes to farm livestock. But he says 60 per cent is the most return of potash a farmer can expect through manure, even when all the farm feed goes to livestock.

Liming decreases potash availability, too. Some soils in the past showed no potash deficiency, but needed that nutrient after six or eight years of heavy liming. Phosphates, on the other hand become more available following heavy liming.

Chapman recommends high-potash fertilizer such as 0-20-20, 0-10-20, and 0-10-30, at rates up to 1,000 pounds per acre for legume seedings. Where nitrogen is needed as well as potash, he recommends a 5-20-20, 4-16-16, or 10-10-10 fertilizer.

Why Buy Earthworms?

"THERE is nothing to be gained from buying earthworms to improve soil," according to Milton A. Miller, Associate Professor of Zoology on the Davis campus of the University of California.

The Zoology Department annually receives many inquiries about the commercial possibilities of earthworms. Last year 52 persons wrote asking how to obtain earthworms, how to raise them, what benefit they were in gardens and orchards, how to culture them for fish bait, and many other questions regarding their profitability.

Many of the requests for information apparently have been stimulated by popular magazine articles on "earthworm farming" or by promoters who exaggerate claims about "hybrid worms."

"In spite of the many ways that earthworms might improve the soil," Miller said, "there is no experimental evidence that earthworm activity alone will increase its productivity except in very special instances where crop growth is limited by exceedingly poor soil structure.

"The public should be wary of exaggerated claims as to the benefits to be derived from 'seeding' the soil with earthworms, or the profits to be obtained from making a business of raising and selling worms.

"The question is not, do earthworms help the soil; but rather, how do earthworms compare on an economic basis with other methods for soil improvement?"

The purchase or propagation of earthworms for soil improvement is not recommended. In the opinion of competent agricultural advisers, soil can be enriched much more quickly, economically, and with less financial risk by the addition of manure, commercial fertilizer, or the use of cover crops and tillage.

"Raising worms for fish bait is, however, perfectly legitimate and can be profitable," said Miller. Persons considering such a venture should learn something of the risks and expenses involved. The market for earthworms as fish bait is seasonal.

Earthworms are, in some situations, economic pests, especially when overly abundant. Their castings (manure) may be a nuisance on golf greens and lawns where a smooth surface is desired. Also, earthworms may transmit the gapeworm parasite of fowls and are therefore undesirable around poultry ranches.

Adjustments . . .

(*From page* 5)

turned into realities, so that in what seemed like a short time (except to those who managed the miracle) the features of the region again resumed their wonted shape and life began once more where torrents laid it low.

Sometimes there were utter crop failures in dry seasons, all the spring tasks so bravely begun came to naught, and a winter of scant margins, reviving faith, and new adjustments loomed ahead. Ravaging pests and plant diseases likewise tortured the farmers at intervals, so that they felt helpless without the strong arm of science to step in and aid them in their dire extremity.

Marketing projects came into being with a loud hurrah and many hosannas, only to be bitten with neglect or bad management. Here again the crying need was for adjustments, not for quitting. A time to plan well and plan over again; to build for everyone, not just for a few! And they did it because for a century adjustments were the main regulators of their lives. A man who stands and kicks can't climb, they said. Adjustments were part of their destiny and their balance wheel.

Perhaps one main reason for this is that there are many times more valley farm folks—young and old—lying in eternal rest on the green acres of Bender's Hill than there are active operators of the farmsteads now. And for everyone of those lives that ended and for everyone who had a personal loss and mourned grievously there had to be, under God's love, a solemn adjustment made. Hence they look to the work of the future and the plans of the living, remembering this was the way that all the other deadly enemies were conquered whenever deep troubles came to our old valley.

Without much doubt, the heaviest burden that one must accept in life's perplexing story is to try to make a

Left—untreated onion; Right—treated with MH-40

Naugatuck nips storage growth in bud!

Naugatuck Chemical has good reason to believe it has dealt a death blow to destructive storage growth of crops such as onions. The reason is a unique new chemical—a water-soluble salt containing 40% maleic hydrazide and called MH-40.*

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MH-40 is one more example of Naugatuck know-how at work, always striving to introduce new and better products to the agricultural field.

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producers of seed protectants, fungicides, miticides, insecticides, growth retardants, herbicides; Spergon, Phygon, Aramite, Synklor, MH, Alanap.

fairly calm adjustment when some great friend and strong companion passes to the Land Beyond. Kind relatives and good associates try their very best to make amends for that eternal absence and to help fill the void left by the loss of that voice and presence that so long sustained one. When the mourner is young when thus bereft, the avenues of life usually unfold scenery and opportunities which in due time overcome the bitterness of loss and gradually heal the scar and dull the pain. Yet for the loved one who is left as threescore years mount higher, only two bright lights remain to bring serenity—to do something worth while for someone else in life's short span; and to trust in the certainty of immortality, with all the joy of renewal and reunion in that Sometime bound to come.

Another of life's severe assignments in adjustment lies with that person who has been handicapped or bedridden by physical ailments. When such brave hearts come through manfully and meet the terrors of the test—so that those who mingle with them find no cause for pity or revulsion—they have set so high and fine a goal that those of us who worry over minor things become subdued and amazed at their superhuman power to overcome and rise unconquered. Those who try to adjust themselves after bereavement or sudden physical mischance have a much harder prospect to face in breaking with former customary ways and means than the dear public ever has to fear from "regimented" policies.

Finally, we come to the realm of the human mind and everyday procedures to see if there is any regimentation existent. Well, what is it that causes us to go herdlike and huddled in our tastes and enthusiasms? Are we afraid of our inner sources of individuality and forgetful of our own moral right to question why some of these daily behaviors are thrust upon us unchallenged?

As somebody says, we possess the "fear of the untypical," and we keep

on hunting for security within the confined walls of secular uniformity. We are in an era of a growing standardization of cultural and educational influences. We are encouraged to be passive and yielding and to run with the mob. We dress, hear, eat, live, and read much alike. This gives the opportunists of all kinds a good chance to exploit the situation. It lies not merely in the field of humdrum routine, but can be used to start popular emotional currents.

Such currents are always negative in manner. They are usually "against" something, seldom favor any positive and constructive plan. They appeal to man's capacity for hatred and fear, never to his capacity for forgiveness, charity, and understanding.

This to me means that we must not be afraid of making our own mental adjustments, trying to see through the arguments and persuasive doctrines aimed at us, instead of just relaxing and taking it all in with a nod of satisfied agreement. The dad whose boy keeps pestering him with vexing questions should take heed of that wonderful attribute his son possesses, and try it on himself a little now and then. Most of us quit asking ourselves hard questions too soon.

So we need not be so agitated over the false pictures of regimentation we have drawn for us. It's the insidious and less apparent types, the familiar daily doses that we take, that poison us and make us blind. Unfortunately the politician has no perfect cure for this because he usually is a part of it himself. But he could have if he stood on a platform of encouragement to individual thinking rather than mass hysteria and popular misunderstandings.

The ripe question left is—would we support and vote for such an enlightened guy or just let those who regiment us now continue undisturbed? Would it be a little too hard to exert our own gray matter rather than to let the men behind the cameras and typewriters tell us what to think about and how?

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LaMotte Soil Testing Service is the direct result of 30 years of extensive cooperative research with agronomists and expert soil technologists to provide simplified soil testing methods. These methods are based on fundamentally sound chemical reactions adapted to the study of soils, and have proved to be invaluable aids in diagnosing deficiencies in plant food constituents. These methods are flexible and are capable of application to all types of soil with proper interpretation to compensate for any special soil conditions encountered.

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FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

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The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)

Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
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DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.

Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: Canadian Film Institute, 172 Wellington Street, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

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S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
QQ-12-44 Leaf Analysis—A Guide to Better Crops
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Knighthood's flower seems to wilt a little with each succeeding generation. A father whose teen-age son learned to dance at camp this summer said to him: "Makes you feel silly, doesn't it, the first time you go up to a girl and say, 'May I have this dance, please?' "

The teen-ager looked offended. "Aw, I never said anything that corny."

"No? What did you say?"

"I'd stroll around and look 'em over till I saw one that was kinda cute. Then I'd point to her and say 'You'll do.' "

* * *

I had sworn to be a bachelor
She had sworn to be a bride
But I guess you know the answer
She had nature on her side!

* * *

Many a man has stopped calling his wife "the little woman" after taking a good look at her in slacks.

* * *

The coon hunter was telling about a smart hound he owned. "All I had to do was whittle out a coon hide stretcher the size of the coon I wanted and show it to the dog, and when he had the right sized coon treed he'd start bayin' and all I had to do was go get him. About two years ago my wife happened to set her ironing board outside and I ain't seen the dog since."

"John, let's don't let the people on the train know we've been married less than an hour."

"Okay. You read a book and I'll go talk to the blonde in Section 13."

* * *

Speaking of accidents, did you hear the one about the farmer who was taking a physical exam to get life insurance? The doctor asked him if he had ever had a serious illness.

"No."

"Ever had an accident?"

"No."

"Never had a single accident in your life?"

"Can't say as I have. But last Spring when I was out in the pasture, a bull tossed me over the fence."

"Don't you call that an accident?"

"Nope. That durned bull did it on purpose."

* * *

Little boy watching milkman's horse: "Mister, I'll bet you ain't gonna get home with your wagon."

Milkman: "Why."

Little Boy: " 'Cause your horse just lost his gasoline."

* * *

Bill: "Will, better stop looking at the girls, now that you're married."

Will: "Listen, brother, you can still look at a menu, even though you're on a diet."

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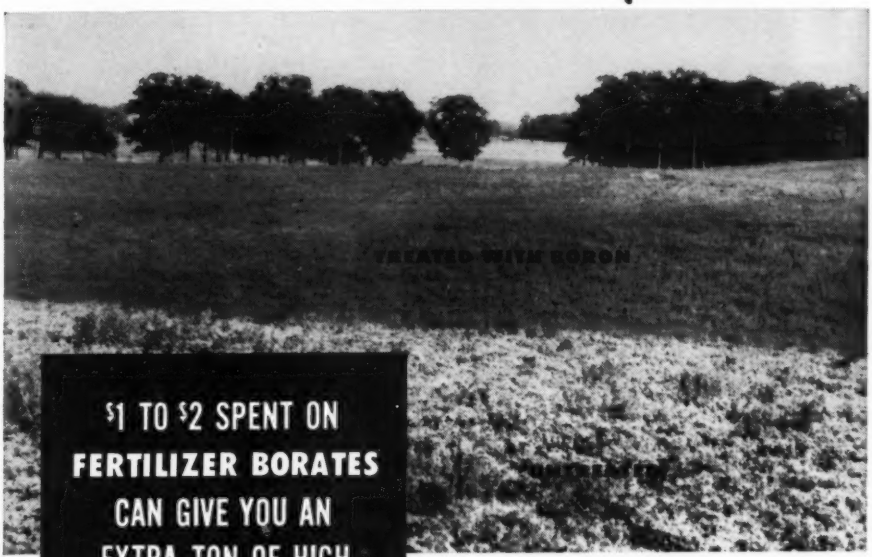

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